Large-Format Submillimeter / Millimeter-Wave Cameras and Spectrometers for CCAT and Beyond (SWCam LWCam X-Spec)

Completed Technology Project (2012 - 2017)

Project Introduction

Kinetic Inductance Detector (KID) technology is maturing rapidly, both in the US and abroad, with photon-noise-limited arrays now being fielded in formats up to ~1000. The Cerro-Chajnantor Atacama Telescope (CCAT) will be the world's submillimeter-wave discovery machine. It is recognized as a powerful complement to ALMA, and has been strongly recommended by the Decadal Survey of Astronomy, Astro2010. CCAT requires arrays of 50,000 or more pixels, presents an opportunity to field JPL arrays and demonstrate them in a world-leading scientific application. In this project we are developing technology for 3 proposed instruments: 2 cameras (SWCam, LWCam), and a multi-object spectrometer X-Spec. All of these use Titanium Nitride (TiN) KIDs with readout frequencies in the 50-250 MHz range.

SWCam is CCAT's short-wavelength camera. It will image at 350 μm, possibly also 450 and 200 μm. Photons are absorbed directly in the TiN inductor which, together with the interdigitated capacitor, forms the KID resonator. A 432-pixel prototype array has been demonstrated at the Caltech Submillimeter Observatory (CSO), showing good yield and reasonable systematics. During this year we plan to deliver a second-generation array with increased response to improve sensitivity. This will be obtained with a smaller inductor, which is coupled with an array of lenses. We expect to demonstrate photon-noise-limited performance demonstrated at realistic sky loadings for CCAT (<50 pW per pixel). A second deliverable is a demonstration array which operates in a different band, either 200 μm, 450 μm, or 850 μm, as SWCam. LWCam is CCAT's long-wavelength camera. It will image at 750 μm, 860 μm, 1.1 mm, 1.3 mm, 2.0 mm, and 3.3 mm, with a total of ~50,000 detectors. The multi-color information provides discriminating power for dusty galaxies, galaxy clusters (as probed with the Sunyaev-Zeldovich (S-Z) effect), and star-formation regions. It uses multi-scale phase-array antennas which are coupled via transmission lines to on-chip bandpass filters and the TiN KIDs. Deliverables this year include a full LW Cam prototype chip with 3-scale antenna, demonstrating good efficiency, beamshape, and sensitivity.

Anticipated Benefits

N/A

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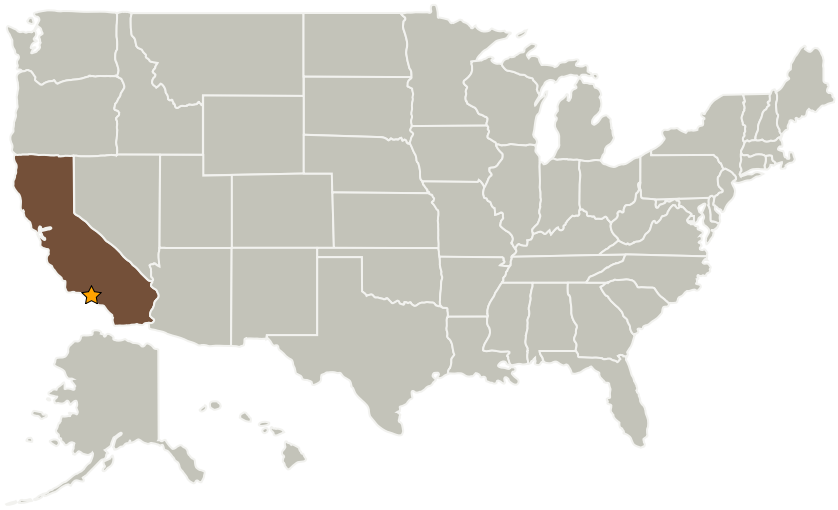
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Jet Propulsion Laboratory(JPL)	Lead Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations
California

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Jet Propulsion Laboratory (JPL)

Responsible Program:

Center Independent Research & Development: JPL IRAD

Project Management

Program Manager:

Fred Y Hadaegh

Project Manager:

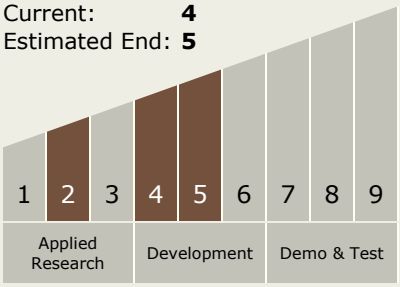
Jonas Zmuidzinas

Principal Investigator:

Charles M Bradford

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **5**



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Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes